

BACK SCATTER

Blu-ray microscope with blood-cell lens

A traditional light microscope can have a large field of view with poor resolution or a small field of view with good resolution but not both. To address that limitation, Guoan Zheng at the University of Connecticut and his colleagues developed a high-resolution computational biolens. They smeared a monolayer of blood cells on top of an image sensor and fixed the cells in place with alcohol. The blood-cell layer redirects light diffracted at a large angle by an object of interest to smaller angles that reach the image sensor. Previously inaccessible high-resolution details can then be acquired using the sensor's pixel array underneath the blood-cell layer. The biolens's field of view is limited only by the size of the silicon chip for the image sensor, which can be as large as 36 mm by 24 mm.

The microscope prototype shown here was built using a modified Blu-ray player, which makes it inexpensive, compact, and portable.

Biological samples were affixed atop the transparent rotating disk in the photo, and the blood-coated sensor was mounted on the translation stage of the player. As the disk rotated, the Blu-ray player's 405 nm laser illuminated the samples. The resulting coherent diffraction patterns from the biological samples were recorded by the blood-coated sensor. At the heart of the image-reconstruction process is a lensless coherent-diffraction-imaging algorithm termed rotational ptychography. (For more on ptychography, see the article by Manuel Guizar-Sicairos and Pierre Thibault, *PHYSICS TODAY*, September 2021, page 42.) A model of the spinning disk and light diffraction recovers the high-resolution sample image with both intensity and phase information. In a proof of concept, the researchers monitored live bacterial cultures across an entire 35 mm petri dish and resolved individual cells. (S. Jiang et al., *ACS Sens.* **7**, 1058, 2022; photo courtesy of Guoan Zheng.)

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